

► which assesses the reproducibility of findings in oncology and is led by the Center for Open Science in Charlottesville, Virginia, and the Science Exchange in Palo Alto, California.

Created using a collection of open-source tools called the *eLife* Reproducible Document Stack, the reproducible article looks like any other, except that each figure is adorned with a small blue arrow. When the user clicks that icon, the programming code used to produce the figure is revealed in a live, inline text editor. As the user alters the code, the figure updates, allowing the user to adjust the presentation of

data (see ‘Computational reproducibility’) or test the effects of removing outliers.

Casey Greene, a bioinformatician at the University of Pennsylvania’s Perelman School of Medicine in Philadelphia, notes, for instance, that the article summarizes some of its data using a bar chart with error bars. It’s a configuration sometimes disparagingly referred to as a dynamite plot because of its resemblance to a Wild West-style explosives detonator — and its potential to obscure the underlying data. Using this reproducible article, a reader can recreate that plot in another style to reveal trends more

effectively. However, they cannot yet share such a modification with other readers, a feature that Greene would like to see. “That, to me, would be a clear win for this technology,” he says.

The article is missing references and supplementary figures, but Maciocco says those will be available in future such articles.

Study author Tim Errington, director of research at the Center for Open Science, says the document represents an evolution of the research article. “The question is, great, now what do we do? How do we keep making this better?” ■



Nobel-prizewinning biologist Paul Nurse fears UK research will lose money after Brexit.

Q&A Paul Nurse

Brexit: ‘UK science is headed for disaster’

As departure day approaches, the director of the Francis Crick Institute says he fears science will drop off the agenda.

For Nobel-prizewinning geneticist Paul Nurse, the gloves are off. Brexit is less than one month away, and Nurse — director of London’s Francis Crick Institute — says that UK research is headed for catastrophe.

Most feared is a ‘no deal’ Brexit scenario, which looms ever closer because the UK Parliament has yet to make an agreement on the terms on which the country will leave the European Union. A deal would allow the United Kingdom to enter a transition period in which many elements of the UK–EU relationship, including valuable EU science funding,

would remain largely the same until 2021. But unless the Brexit deadline is extended, the country will crash out of the bloc without a deal on 29 March — immediately affecting trade, immigration and EU research funding.

Although the UK government has guaranteed to replace the money for existing EU grants and successful bids submitted before 2021, details about how this would work are lacking — worrying researchers. UK scientists would no longer be able to host new grants from the European Research Council (ERC), which gives out prestigious, investigator-driven awards.

Nurse spoke to *Nature* about the long- and short-term risks of Brexit for science.

How confident are you that the UK government will be able to implement its research-funding guarantee?

The statements that we hear are relatively reassuring. But the problem is that it’s such a shambles that it’s difficult to be fully confident and trust what’s being said. The science ministers have probably tried their best, but, frankly, it’s out of their control as well. I worry that if Brexit happens, then science won’t have the influence and profile it will need to be protected, and that we may fall off the end of the agenda.

When does it become unacceptable that scientists don’t know what’s going to happen on 30 March?

The short answer is that it’s unacceptable now. We are in a time of utter chaos. Let’s be blunt — there’s a complete failure of political leadership in this country, both on the left and on the right. Leaders have sleepwalked the nation into what I think is a big disaster for science. So I have no hesitation in saying that it’s unacceptable now.

But it’s understandable that we will fall off the agenda because the government has got immense problems to tackle — when the ‘Brexiters’ [politicians in favour of Brexit] came out and said it’s all going to be simple, they simply hadn’t got a clue. So it will continue because it’s just so chaotic.

In a no-deal situation, the UK government might create its own version of the European Research Council. What are your thoughts?

A problem I think colleagues worry about is will an ERC replacement be as open-ended in the way the money is allocated as the ERC? The ERC supports quality, investigator-led research, wherever it may be. The question is: will the UK government be as open, or will they, as governments have a tendency to do, meddle and support their particular pet initiatives? Allocating money to particular areas is important, but it’s only one end of the science spectrum, and one that always relies on discovery research. If

I talk to the UK Research Councils [which disburse UK-government grants], they say the government understands this issue and won't do that. If you're asking, am I fully confident I have to say that I have my doubts.

If the United Kingdom were to start an ERC-like scheme, how should it work?

Ideally, the United Kingdom will, in the future, participate fully in the EU's major science-funding programmes, allowing continued access to the ERC. If not, as long as a UK equivalent was properly managed, my own view is that it would be right to put this under the umbrella of UK Research and Innovation [the country's central research funder].

From 2021, the United Kingdom might be able to take part in some aspects of the next EU science-funding scheme, Horizon Europe. Do you foresee any long-term risks?

Currently, the United Kingdom gets back from the EU science budget between £500 million (US\$666 million) and £1 billion a year more than we put in. Beyond any Brexit transition period, there is absolutely no guarantee from the Treasury that they will replace that funding.

That means that UK research will lose up to £1 billion a year after Brexit. Over the past year, I've repeatedly asked ministers: 'Where

is that money coming from?' They have no answer, so the United Kingdom is almost guaranteed to lose that money. In the long term, the government needs to find another billion and that has to come from another department's budget.

More than one-quarter of the lab technicians at the Francis Crick Institute are from continental Europe. What are some of your concerns about immigration after Brexit?

These skilled technicians come here freely and contribute greatly to the United Kingdom's scientific endeavour and economy. Unfortunately, the government has made it clear that these continental Europeans will end up being subject to the existing, inadequate visa system.

The conditions of the visas are such that the Crick will have difficulties hiring anyone who earns less than £30,000 a year, which is damaging. The government doesn't seem to understand this and they have to sort it out. None of this is good for UK science, and what isn't good for UK science isn't good for the United Kingdom.

Many people want a second referendum on Brexit. Do you think scientists will push for one?

The scientific community, top to bottom, is overwhelmingly against Brexit. I have this

naive faith that, normally, the British are not this stupid. Gradually, Parliament is waking up to the fact that it is sleepwalking into disaster. I'm hoping that over the next 30 days Parliament will realize the need to call for an extension, so we can have more time to talk about it.

And, in my view, ultimately, we do need a second referendum because the first referendum was so strongly informed by misunderstanding and even mistruths of a gargantuan type. This is a madness that normally the British find a way through, so let's hope that we do. ■

INTERVIEW BY ELIZABETH GIBNEY

This interview has been edited for length and clarity.

CORRECTION

The News Feature 'On the edge of the periodic table' (*Nature* **565**, 552–555; 2019) erred in saying that no isotopes have been found for elements 109–111 that live long enough for chemical studies. In fact, the problem is not the length of the half-lives, but that the isotopes are created in decay chains, not through collisions. The feature also mislabelled the y axis of the graph 'The superheavy realm'.



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